

COLUMBIA LIBRARIES OFFSITE
HEALTH SCIENCES STANDARD



HX64166147

RJ496.P2 G76 A note on the presen

RECAP

Robert Graham

A note on the presence of *B. Botulinus*
Type A in the excretions of poliomyelitis
patients.

23496.22

Columbia University
in the City of New York

COLLEGE OF
PHYSICIANS AND SURGEONS
LIBRARY





Digitized by the Internet Archive
in 2010 with funding from
Open Knowledge Commons

<http://www.archive.org/details/noteonpresenceof00grah>

ham-Robert

UNIVERSITY OF ILLINOIS BULLETIN

ISSUED WEEKLY

Vol. XIX

OCTOBER 17, 1921

No. 7

[Entered as second-class matter December 11, 1912, at the post office at Urbana, Illinois, under the Act of August 24, 1912. Acceptance for mailing at the special rate of postage provided for in section 1103, Act of October 3, 1917, authorized July 31, 1918.]

A NOTE ON THE PRESENCE OF B. BOTULINUS TYPE A IN THE EXCRETIONS OF POLIOMYELITIS PATIENTS

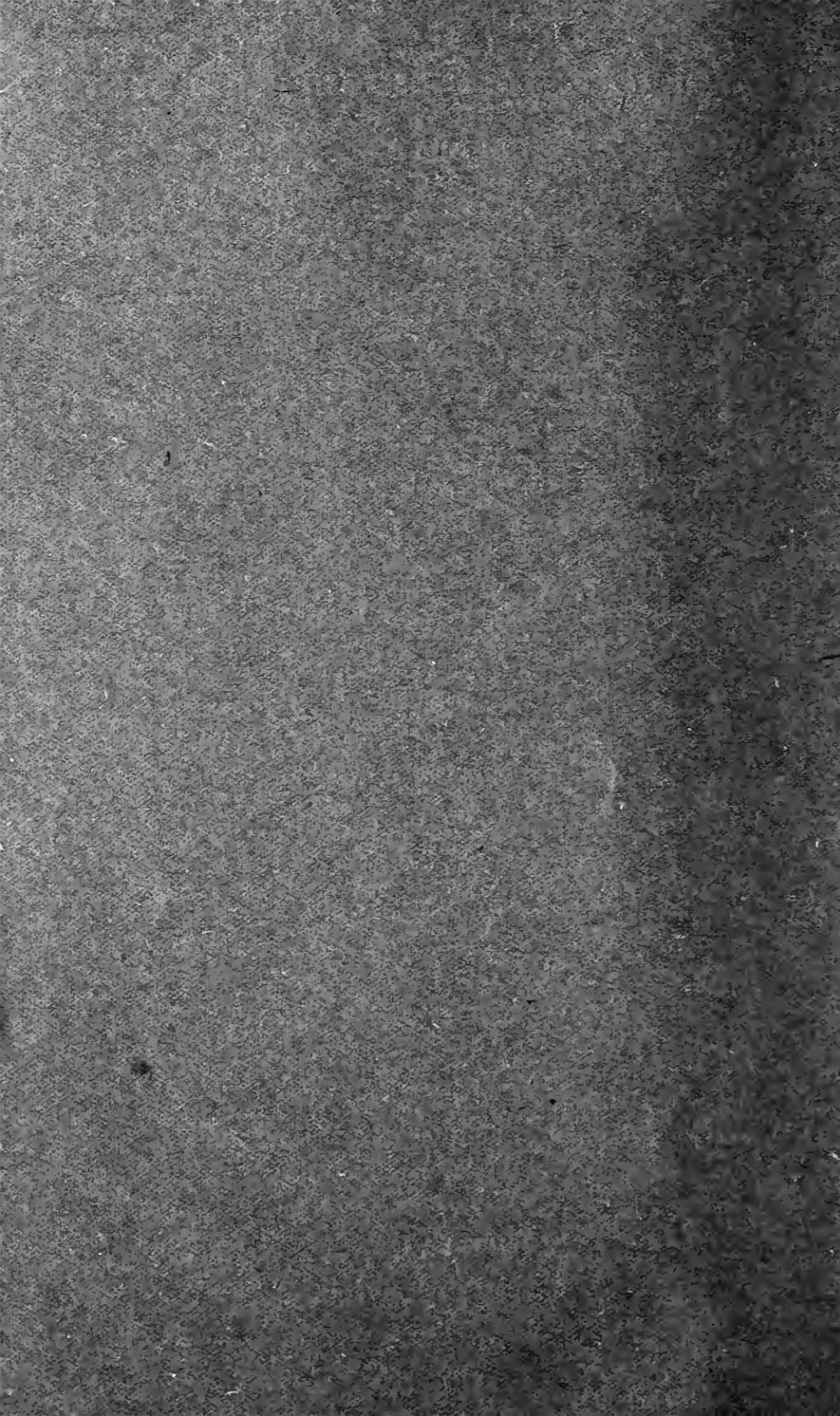
BY ROBERT GRAHAM AND EDGAR BARGER
LABORATORY OF ANIMAL PATHOLOGY AND HYGIENE



PUBLISHED BY THE UNIVERSITY OF ILLINOIS
URBANA

NOVEMBER 9, 1921

Columbia University
College of Physicians and Surgeons
Library

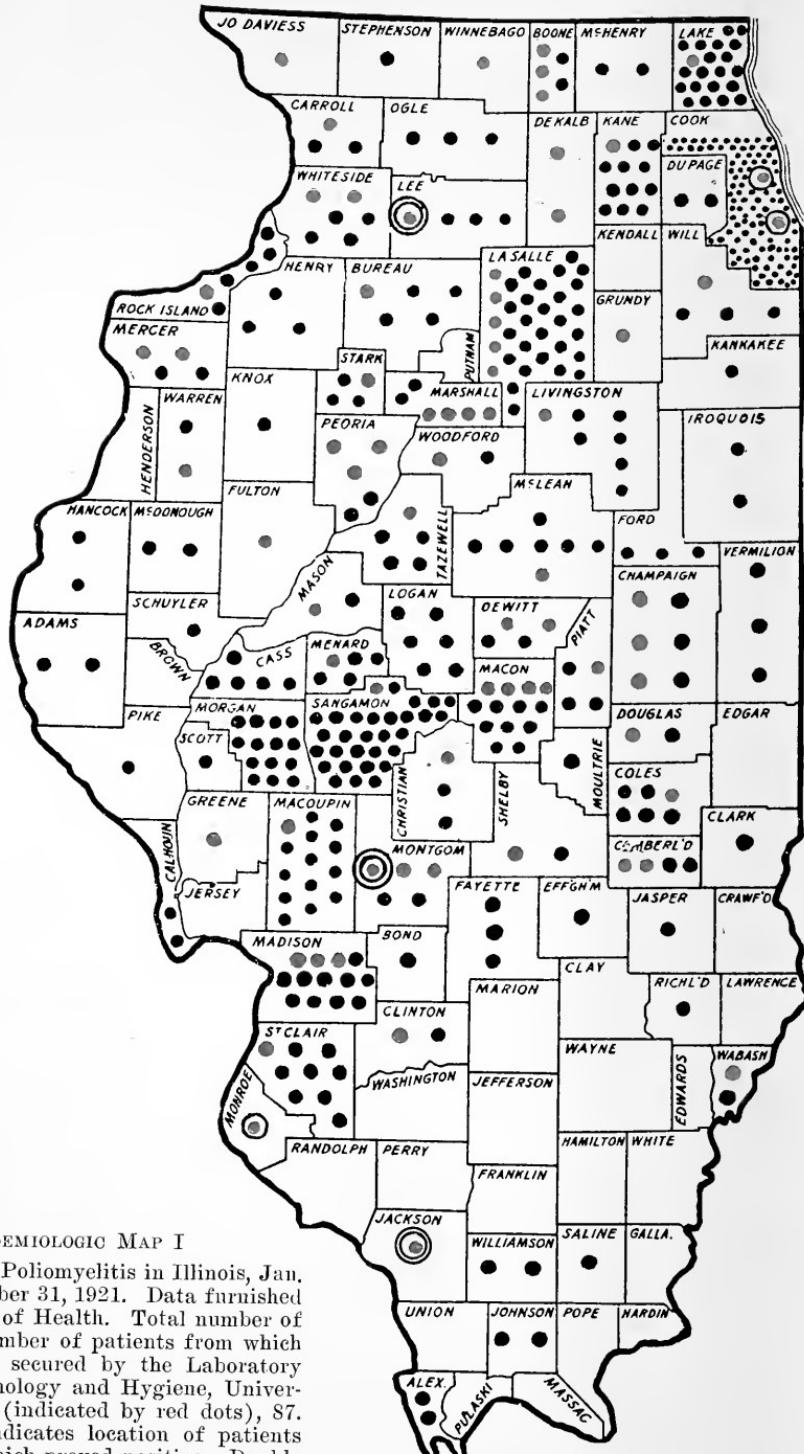


A NOTE ON THE PRESENCE OF
B. BOTULINUS TYPE A IN THE EXCRETIONS
OF POLIOMYELITIS PATIENTS

BY ROBERT GRAHAM AND EDGAR BARGER
LABORATORY OF ANIMAL PATHOLOGY AND HYGIENE

PUBLISHED BY THE UNIVERSITY OF ILLINOIS
URBANA

NOVEMBER 9, 1921



EPIDEMIOLOGIC MAP I

Outbreaks of Poliomyelitis in Illinois, Jan. 1, 1920, to October 31, 1921. Data furnished by State Board of Health. Total number of cases, 463. Number of patients from which specimens were secured by the Laboratory of Animal Pathology and Hygiene, University of Illinois (indicated by red dots), 87. Single circle indicates location of patients excretions of which proved positive. Double circle indicates location of patients excretions of which proved positive but which are not discussed in this leaflet.

A NOTE ON THE PRESENCE OF *B. BOTULINUS* TYPE A IN THE EXCRETIONS OF POLIOMYELITIS PATIENTS

BY ROBERT GRAHAM AND EDGAR BARGER,
LABORATORY OF ANIMAL PATHOLOGY AND HYGIENE, UNIVERSITY OF ILLINOIS

Thru the cooperation of health officials, hospitals, and practicing physicians of Illinois,¹ specimens of excretions from children suffering from poliomyelitis have been submitted to the Laboratory of Animal Pathology and Hygiene for examination. Sterile containers were mailed to the attending physician and the samples of urine and feces as collected were cultured immediately upon arrival at the laboratory. The purpose of this leaflet is to record the presence of *B. botulinus* type A in one feces and two urines of children during the convalescent period of a poliomyelitis infection.² The bacteriologic studies here reported are limited to samples of urine and feces from cases diagnosed as poliomyelitis.

The possibility of *B. botulinus* as a saprophytic contaminant of the alimentary tract of healthy children as well as the possibility of this microorganism being present in the normal genito-urinary tract is not disregarded in the preliminary investigations. Furthermore, the method employed in collecting specimens may not have sufficed to eliminate extraneous contamination. In any event, it seems a noteworthy fact that *B. botulinus* should be encountered in excretions from the human body, and even tho upon further study it should be established that this microorganism bears no relation to the neurotropic virus of poliomyelitis or an analogous symptom complex in children, the widespread character of *B. botulinus* in nature will be more fully understood.

Poliomyelitis as an investigational problem came to our attention in connection with studies conducted during the past five years relative to the etiologic character of certain obscure toxemic syndromes in domestic animals. The results of these studies have shown that

¹ Grateful acknowledgment is hereby made for the helpful cooperation and assistance given by the Illinois State and Chicago Boards of Health, as well as the Cook County and Durand Hospitals of Chicago, Dr. C. W. East, Dr. J. J. McShane, Dr. C. G. Appelle, Dr. W. E. Schowengerdt, Dr. Butler, and many other practitioners of human medicine.

² Since this report was written, three specimens of urine (188, 242, and 395) from three other convalescent cases of poliomyelitis have upon bacteriologic examination revealed the presence of *B. botulinus* type A. The geographic locations of these three cases are indicated on epidemiologic Map I by a red dot surrounded by two circles.

botulism is a rather common disease thruout the Mississippi valley, affecting swine, chickens, cattle, sheep, and horses. (See Maps III and IV.) Notwithstanding the fact that Flexner and others working in the field of poliomyelitis have disregarded the possible relation between spinal paralysis in farm animals and poliomyelitis in children, certain clinieal and epidemiologic observations in animal botulism with special reference to poliomyelitis in children as it occurred in Illinois during the late summer months of 1921 failed to clearly and decisively eliminate the possible etiologic connection between all cases of poliomyelitis and botulism in animals.

A knowledge of the varying symptoms of botulism in animals suggested that the clinical aspects of a *botulinus* intoxication in man might also vary markedly.¹ The clinical analogy between spontaneous botulism in nursing lambs as it occurred in Champaign county, Illinois (1917), to poliomyelitis in children also suggested the possibility of a common etiologic factor. Furthermore, the resistance of the bovine species to contaminated rations pointed to the possible danger of milk from apparently healthy lactating animals consuming contaminated grains and hays. Experimental data bearing on the relation of *B. botulinus* and toxin in the feed of the healthy lactating animal to the presence of the virus in fresh milk apparently suggest an explanation of the sporadic occurrence of some cases of spontaneous *botulinus* intoxication in the nursing young animals. The specific toxic character of milk from apparently healthy animals ingesting definite amounts of *botulinus* virus can be occasionally demonstrated in guinea pigs. In one instance Dingman² rather definitely recorded the possible relation of the milk supply to the occurrence of a disease in children diagnosed as poliomyelitis (New York, 1916). In three widely separated boarding houses patronizing the same milk dairy, cases of poliomyelitis were observed. In three other families in the community which were furnished milk from the same supply no cases of poliomyelitis occurred. An investigation revealed the fact that the milk was always boiled by the latter three families while the former three families used the milk raw. If Dingman was dealing with cases of botulism, other possible modes of transmission are obviously not excluded in view of the fact that *botulinus* toxin and spores have been demonstrated in other foods as well as in the larvac of the *Lucilia caesar* and in the mature fly.

¹ Recently, this contention was confirmed in connection with an acute gastrointestinal disturbance in children from eating fig newtons in one family and bread in another which upon examination were found to contain *B. botulinus* type A. The symptoms were not analogous to known cases of botulism in adult persons.

² Dingman, J. C. New York State Journal of Medicine, 16, 589. 1916.

The possible significance of the experimental findings in the milk of lactating animals consuming contaminated rations, if any, in relation to the health of the milk-consuming public suggested the occurrence of some disease of a cryptogenic etiology in man. The conjecture that such a disease might more often occur in children than in adults would naturally follow because of the dietary difference or varying tolerance of the two groups. A resumé of the literature on prevailing paralytic diseases of children with particular reference to numerous reports on poliomyelitis and the modes of transmission presents a conception of poliomyelitis which conflicts with the disease as experimentally produced and fails to harmonize with the generally accepted ideas regarding other infectious diseases. In this connection the possibility of a food transmission is not entirely disregarded. These and other facts suggested the advisability of attempting a comparative study of poliomyelitis in children from the standpoint of pathogenic anaerobes, with particular reference to *B. botulinus*.

Observations in animal botulism indicate that the symptomatology of a botulinus intoxication in children might not be easily recognized on the basis of the syndrome of this intoxication observed in mature persons. In fact, there has been no more perplexing problem in animal botulism than the clinical diagnosis of the disease, not only in different animal species, but in the same species of different ages. If this phenomenon is subject to interpretation it may be explained on the basis that the toxin may affect or localize in different nerve centers and thus induce various forms of local paralysis. In view of the fact that a specific botulinus intoxication in animals has been clinically confused with acute bacterial infections, rabies, and deficiency diseases, it is even possible to suggest that the acute and more easily diagnosed cases of botulism in domestic animals and man constitute but one type of the existing, yet unrecognized, forms of this disease. The syndrome encountered in the classical picture of poliomyelitis as observed in different patients, however, suggested to the writers the possible presence of a neurotropic virus resembling the action of botulinus toxin.

A CLINICAL AND EPIDEMIOLOGICAL NOTE OF THE POLIOMYELITIS PATIENTS

Three of the cases of poliomyelitis in children, wherein *B. botulinus* type A was encountered in the excretions, were reported on the following epidemiologic cards of the Illinois State Department of Health:



FIG. 1.—PATIENT 154

PATIENT 154

ILLINOIS STATE DEPARTMENT OF HEALTH					
COUNTY				CASE	
CITY OR TOWNSHIP		NAME			NO.
					OUTBREAK IN FAMILY
AGE 4	SEX F	MARITAL STATE Single	COLOR W.	NATIONALITY Am.	POLIOMYELITIS
Years	Male-Female	Married-Single-Widowed	White-Black	(Of Mother, if minor)	
ADDRESS: STREET	NUMBER		FLOOR 1	ROOM NO.	CARE OF
REPORTED BY Dr. Zoda D. Lumley	ADDRESS				DATE Sept. 13, 1921.
THE HOUSE:	GENERAL CONDITION Fair			NUMBER OF FAMILIES 1	
STABLE NEAR? (YES) (NO) Yes	EXPOSED GARBAGE, ETC., NOTED? (YES) (NO) Yes				
THE HOME: GENERAL CONDITION (GOOD) (BAD) Fair	FLIES (YES) (NO) Yes	VERMIN (YES) (NO) No			
THE FAMILY: ADULTS 3	CHILDREN 2	1		ON PREMISES SINCE 1 month	
0-5 years	6-10 years	11-30 years			
EXPOSURE TO INFECTION: ANY CONTACT, DIRECT OR INDIRECT, WITH OTHER CASE? (YES) (NO) _____					
DETAILS, DATES OF CONTACT					
INSPECTOR'S DIAGNOSIS Acute anterior poliomyelitis				ONSET DATE Sept. 12th	
PARALYSIS: WHEN FIRST APPEARED Sept. 13,	PARTS AFFECTED left arm				
GENERAL SYMPTOMS: RESPIRATORY No			GASTRO INTESTINAL No		
TYPE: 1 ABORTIVE	2 SPINAL yes	3 MENINGEAL	4 CEREBRAL	LUMBAR PUNCTURE DATE No	RESULT
PRECAUTIONS OBSERVED: ISOLATED (YES) (NO) Yes DEATH No FROM _____					
FOOD HANDLERS IN FAMILY (YES) (NO) Report No	CHILDREN ATTEND SCHOOL AT _____			EXCLUDED Yes	
REMOVAL AND RENOVATION ORDERED Yes-screens	ASSIGNED TO Dr. Henry Reis, Belleville			RETURNED	
(1010-16M-8-18)					

Anamnesis

Sept. 6—Child indisposed. Vomiting and pains in epigastrium.
 Sept. 10, 11—Slight headache.
 Sept. 12—Headache, backache, pain in right arm. Sensation in left arm, described as "worms crawling inside of arm."
 Sept. 13—Left arm showed paralysis of long flexors and shoulder muscles. Slight constipation relieved by mild cathartic.

Diagnosis: Poliomyelitis

Urine as submitted in sterile container September 20, 1921, proved positive to B. botulinus type A.

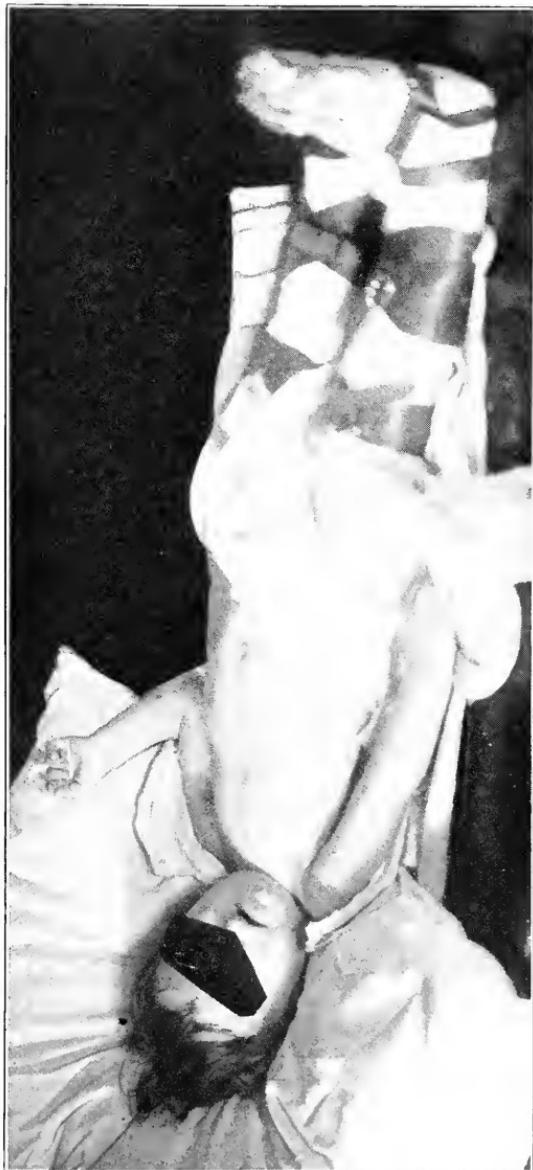


FIG. 2.—PATIENT 269

PATIENT 269

ILLINOIS STATE DEPARTMENT OF HEALTH						CASE	
COUNTY						NO.	
CITY OR TOWNSHIP						OUTBREAK IN FAMILY	
NAME	DATE Sept. 14, 1921					POLIOMYELITIS	
AGE 20 mo SEX F	MARITAL STATE S	COLOR W	NATIONALITY U.S.	OCCUPATION			
Years Male-Female	Married-Single-Worked	White-Black (Or. Mother, if minor)					
ADDRESS STREET Western Ave.	NUMBER 181	FLOOR 2	ROOM NO. 6	CARE OF Dr. Butler			
REPORTED BY H.O.	ADDRESS	DATE					
THE HOUSE: GENERAL CONDITION Fair	NUMBER OF FAMILIES 1						
STABLE NEAR? (YES) NO	EXPOSED GARBAGE, ETC., NOTED? (YES) NO						
THE HOME: GENERAL CONDITION (GOOD) (BAD) F	FLIES (YES) NO	VERMIN (YES) NO					
THE FAMILY: ADULTS 2 CHILDREN 1	ON PREMISES SINCE 3 years						
0-4 years 5-10 years 11-30 years							
EXPOSURE TO INFECTION, ANY CONTACT, DIRECT OR INDIRECT, WITH OTHER CASE? (YES) NO							
DETAILS, DATES OF CONTACT							
INSPECTOR'S DIAGNOSIS Acute anterior poliomyelitis						ONSET: DATE 9-3-21	
PARALYSIS: WHEN FIRST APPEARED 9-9-21 PARTS AFFECTED Right & left, upper & lower extremities							
GENERAL SYMPTOMS RESPIRATORY yes						GASTRO INTESTINAL yes	
TYPE: 1 ABORTIVE	2 SPINAL yes	3 MENINGEAL	4 CEREBRAL	LUMBAR PUNCTURE: DATE	RESULT		
PRECAUTIONS OBSERVED, ISOLATED? (YES) NO						DEATH FROM	
FOOD HANDLERS IN FAMILY: YES (NO) REPORT NO						CHILDREN ATTEND SCHOOL AT NO	EXCLUDED
REMOVAL AND RENOVATION ORDERED						ASSIGNED TO S.S. Winner, M.D.	RETURNED
(10190-10M-8-18)							

Anamnesis

- July — Intermittent attacks of diarrhea and vomiting.
 Sept. 3—Child fell down stairs. Severe cold with purulent green nasal discharge. Diarrhea had subsided during the two weeks preceding this date.
 Sept. 5—Diarrhea, fever, attitude dull. Malaria suspected.
 Sept. 6—Fetid diarrhea, containing mucus. Spasmodic twitching of facial muscles, neck stiff; no Brudzinski, negative Babinski, respirations regular, lungs normal, pulse 140, temperature 102.2°. Glands in neck slightly enlarged.
 Sept. 9—Patient extremely toxic, stares at ceiling, irrational at times, abdominal breathing only, foot pendulous, slight opisthotonus, temperature 102°. Reluctant about moving lower extremities.
 Sept. 10—Paralysis of upper and lower extremities.

Diagnosis: Poliomyelitis

Stool as submitted in sterile container September 26, 1921, proved positive to B. botulinus type A.



FIG. 3.—PATIENT 276

PATIENT 276

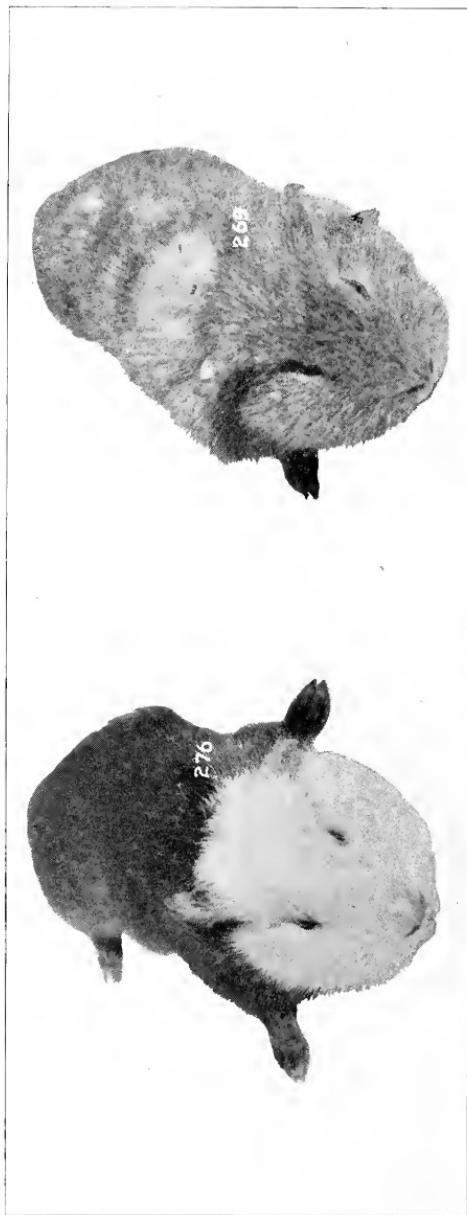
ILLINOIS STATE DEPARTMENT OF HEALTH									
COUNTY		NAME		DATE		CASE NO.		POLIOMYELITIS	
CITY OR TOWNSHIP						NO.		OUTBREAK IN FAMILY	
AGE 5 Years	SEX M Male	MARITAL STATE Married	S Single	COLOR W White	NATIONALITY American	TOP SHEET, B INDEX		OCCUPATION	
ADDRESS STREET	Division	NUMBER	1737	FLOOR	4th	ROOM NO.	CARE OF Dr. Levin		
REPORTED BY Dr. I.M. Levin	ADDRESS					DATE			
THE HOUSE: GENERAL CONDITION Poor					NUMBER OF FAMILIES about 10				
STABLE NEAR? (YES) NO	EXPOSED GARBAGE, ETC., NOTED? (YES) NO		Yes						
THE HOME: GENERAL CONDITION (GOOD) BAD F	FLIES (YES) NO		yes		VERMIN (YES) NO		Yes		
THE FAMILY: ADULTS 2 CHILDREN 1	1—5 years 6—10 years 11—20 years				ON PREMISES SINCE 2 months				
EXPOSURE TO INFECTION: ANY CONTACT, DIRECT OR INDIRECT, WITH OTHER CASE? (YES) NO NO									
DETAILS, DATES OF CONTACT									
INSPECTOR'S DIAGNOSIS acute anterior poliomyelitis					ONSET DATE 9/16/21				
PARALYSIS: WHEN FIRST APPEARED 9/19/21	PARTS AFFECTED Lower left extremity								
GENERAL SYMPTOMS RESPIRATORY GASTROINTESTINAL									
TYPE: 1 ABORTIVE	2 SPINAL	spinal	3 VINGEAL	4 CEREBRAL	LUMBAR PUNCTURE	DATE	RESULT	100 cell increased pressure	
PRECAUTIONS OBSERVED ISOLATED YES NO Hospitalized FROM cloudy									
SCREENS DEATH									
FOOD HANDLERS IN FAMILY YES NO REPORT No	CHILDREN ATTEND SCHOOL AT						EXCLUDED		
REMOVAL AND RENOVATION ORDERED (1920-10-15-S-15)	ASSIGNED TO S.S. Winner M.D.						RETURNED		

Anamnesis

- Sept. 16—Cheeks flushed.
- Sept. 17—Patient vomiting, high fever, irrational, grinding teeth. Spasmodic twitching of hands, constipation, pain in lumbo-sacral region and posterior muscles of left leg. Headache and pain over left eye. Patient in attempting to stand fell over.
- Sept. 19—Pupils dilated, facial and neck muscles normal. Well marked posterior and cervical adenopathy. Temperature 101°. Spasmodic twitching of pectoralis. Partial paralysis of lower left extremity.

Diagnosis: Poliomyelitis

Urine as submitted in sterile container September 27, 1921, proved positive to B. botulinus type A.



Figs. 4 AND 5.—GUINEA PIGS 269 AND 276. PHOTOGRAPHS TAKEN FORTY-EIGHT HOURS AFTER TREATMENT

THE RELATION OF STRAINS 154, 269, AND 276 TO
B. BOTULINUS TYPE A

Ten days after the urine and stool inoculations (154, 269, and 276) were made, the cultures were tested for toxicity by feeding .5 cc to healthy guinea pigs. The toxic effect of cultures 269 and 276 was first noted twenty-four hours after feeding. On the second morning the photographs shown in Figs. 4 and 5 were made, and within a few hours, forty-eight hours after the feeding of the toxin, the pigs were dead. The prostrate condition as observed in these animals is typical of botulinus intoxication in guinea pigs. Death in animals so affected generally follows in a few hours.

The lethal character of the cultures isolated from specimens 154, 269, and 276 to type A botulinus was demonstrated by injecting exposed guinea pigs with antitoxin. The results encountered in culture 154 are identical with those obtained from culture 276. Culture 269 produces a very mild extra-cellular toxin. On October 4, 1921, three guinea pigs were given .5 cc of broth culture 154 via the mouth. Simultaneously pig 76 was given subcutaneously 25 units of botulinus antitoxin type A, and pig 780 was given subcutaneously 25 units of

TABLE 1

G.P.	Toxin 10-4-21	Antitoxin 10-4-21	Results
76	154—.5 cc per orem	25 units botulinus anti-toxin type A, subcutaneously	Remained healthy
780	154—.5 cc per orem	25 units botulinus anti-toxin type B, subcutaneously	Dead 10-5-21
308	154—.5 cc per orem	Control	Dead 10-5-21



FIG. 6.—GUINEA PIGS 76, 780, AND 308, SHOWING PROTECTIVE CHARACTER OF TYPE A ANTITOXIN. PHOTOGRAPH TAKEN TWENTY-FOUR HOURS AFTER TREATMENT

botulinus antitoxin type B. Pig 308 was left as a control. The treatment as administered and the result are presented in Table 1. In Fig. 6 is shown a photograph of the guinea pigs taken twenty-four hours after the treatment.

The immunologic relation of culture 154 to culture 276 was established by a similar procedure wherein the protective character of botulinus antitoxin type A was observed. The toxin and antitoxin were administered as indicated in Table 2. As shown in this same table, the pig which had been injected with botulinus antitoxin type A was the only one of the three which survived at the end of twenty-four hours. See Fig. 7.

TABLE 2

G.P.	Toxin 10-21-21	Antitoxin 10-21-21	Results
856	276—.5 cc per orem	25 units botulinus anti-toxin type A, subcutaneously	Remained healthy
725	276—.5 cc per orem	25 units botulinus anti-toxin type B, subcutaneously	Dead 10-22-21
124	276—.5 cc per orem	Control	Dead 10-22-21

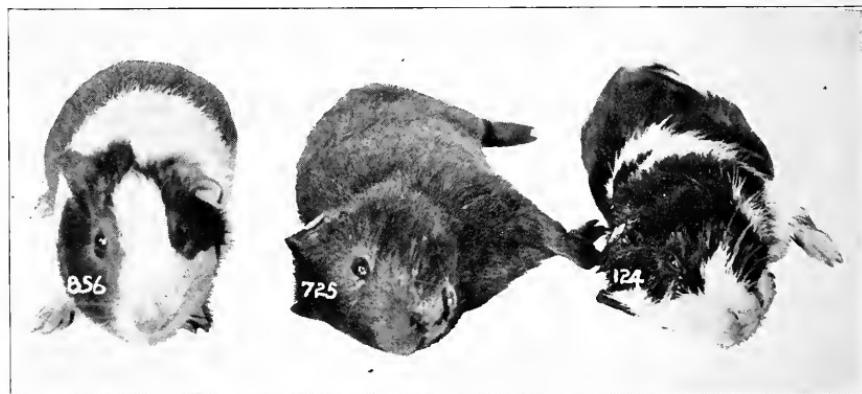


FIG. 7.—GUINEA PIGS 856, 725, AND 124, SHOWING PROTECTIVE CHARACTER OF TYPE A ANTITOXIN. PHOTOGRAPH TAKEN TWENTY-FOUR HOURS AFTER TREATMENT

The toxogenic character of strain 276 for monkeys was observed by feeding the contents of one glucose agar shake culture to a healthy ringtail monkey (white-throated Sapajou or Capuchin, *Cebus hypo-leucus*, No. 734). The culture was fed at 11 a.m., October 22, and the animal then placed in a separate cage and fed wholesome food. Profound toxic symptoms were observed at 7 a.m., October 24. At this time the monkey was able to stand erect for only a moment. An opossum-like attitude (Fig. 8) was assumed as the pendulous head

November 9,

FIG. 8



FIG. 9

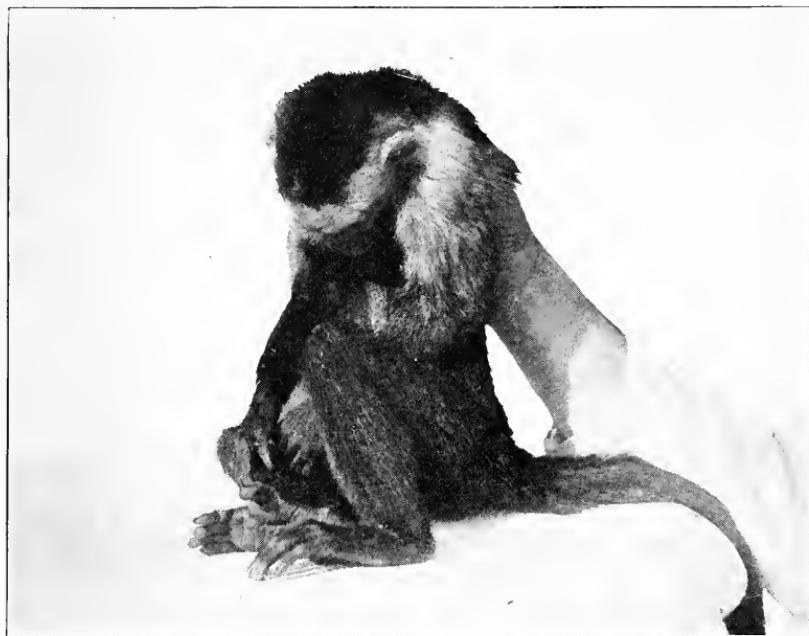


FIG. 10



FIG. 11

FIGS. 8-11.—SYMPTOMS OBSERVED IN MONKEY 734 FORTY-FIVE HOURS AFTER EXPOSURE

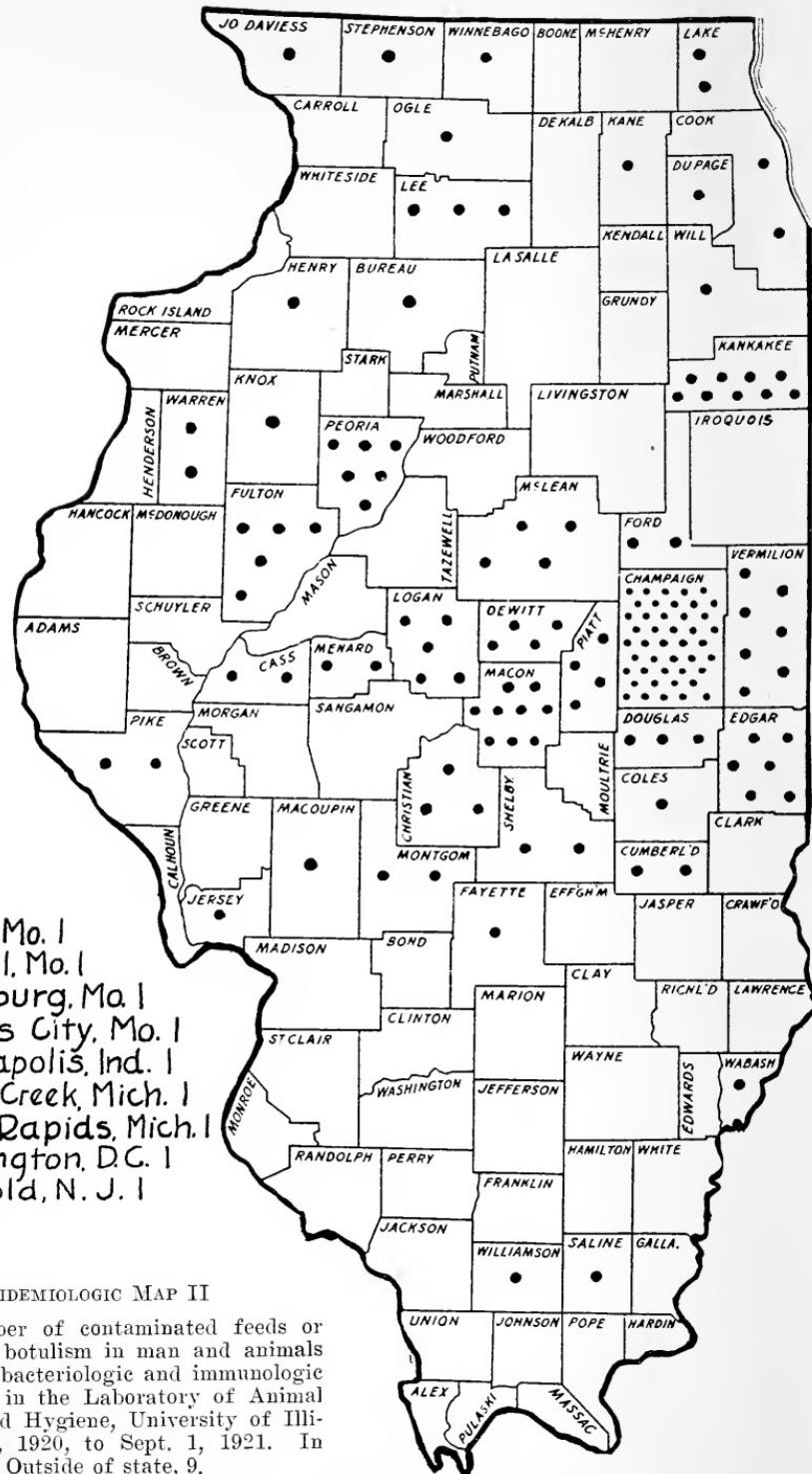
and neck (Figs. 9 and 10) flexed on the forearms. When placed in a standing position with the head erect, the animal fell over and assumed a lateral decumbent position (Fig. 11). The respirations were shallow and irregular. Following exertion, dyspnea and mouth-breathing were pronounced. Complete prostration and coma terminated in respiratory paralysis and death at 11 a.m., October 24.

SUMMARY

Approximately two hundred specimens of body excretions including feces and urine as well as throat swabs from some eighty cases of poliomyelitis are being examined in the Laboratory of Animal Pathology and Hygiene of the University of Illinois, for pathogenic anaerobes. One stool and five urines as submitted from widely separated spontaneous cases of this disease in the state of Illinois have proved positive to *B. botulinus* type A. The syndrome in each of the six cases was regarded as typical of poliomyelitis by the attending physician.

Since other possible factors have not been considered in the preliminary studies, the specific relation of *B. botulinus* type A to poliomyelitis-like diseases is only a matter of conjecture at this time. Furthermore, the number of cases of poliomyelitis in children included in this phase of the investigation is too small to permit the conclusion that *B. botulinus* is an etiologic factor. However, the possibility of a botulism transmission thru milk is experimentally established in animals, and if the human organism reacts similarly, milk may be a factor tho the possibility of transmission thru other foods merits consideration. The rôle of flies or other insects which might mechanically contaminate food, is not excluded in the preliminary studies. In view of these facts, as well as of the neurotropic character of botulinus toxin, it seems advisable not to overlook the possible relation which may exist between some cases of poliomyelitis in children and a specific botulinus intoxication, altho the occurrence of distinct and separate diseases in children, diagnosed as poliomyelitis, is not excluded in this connection.

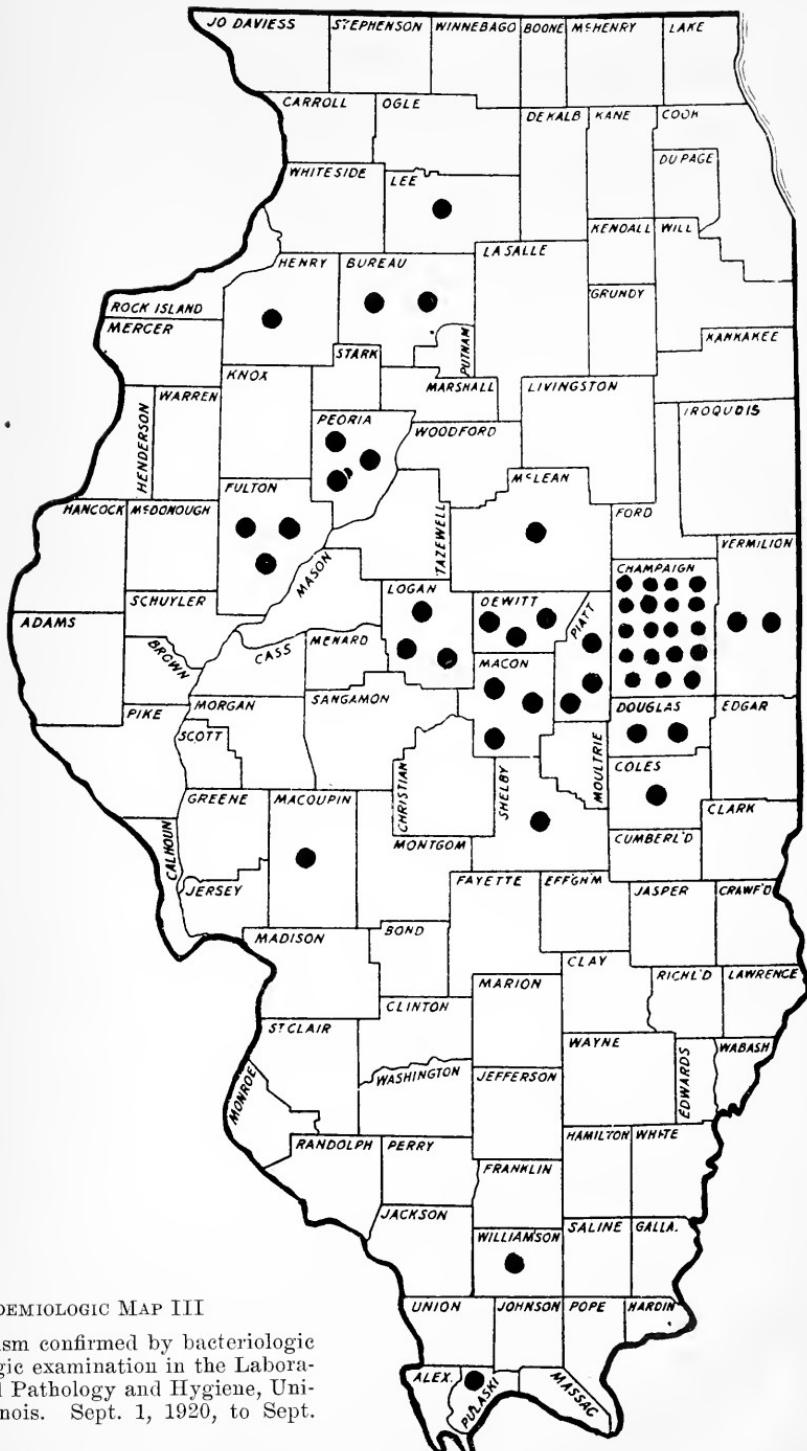
The fact that *B. botulinus* type A has been encountered in the excreta of six convalescent poliomyelitis patients suggests the advisability of continuing the investigations until the saprophytic and toxigenic character of this microorganism in nature is definitely established with special reference to its presence in the excretions of normal children and of patients suffering from a paralytic syndrome.



St. Clair, Mo.
 Marshall, Mo.
 Clarksburg, Mo.
 Kansas City, Mo.
 Indianapolis, Ind.
 Battle Creek, Mich.
 Grand Rapids, Mich.
 Washington, D.C.
 Freehold, N.J.

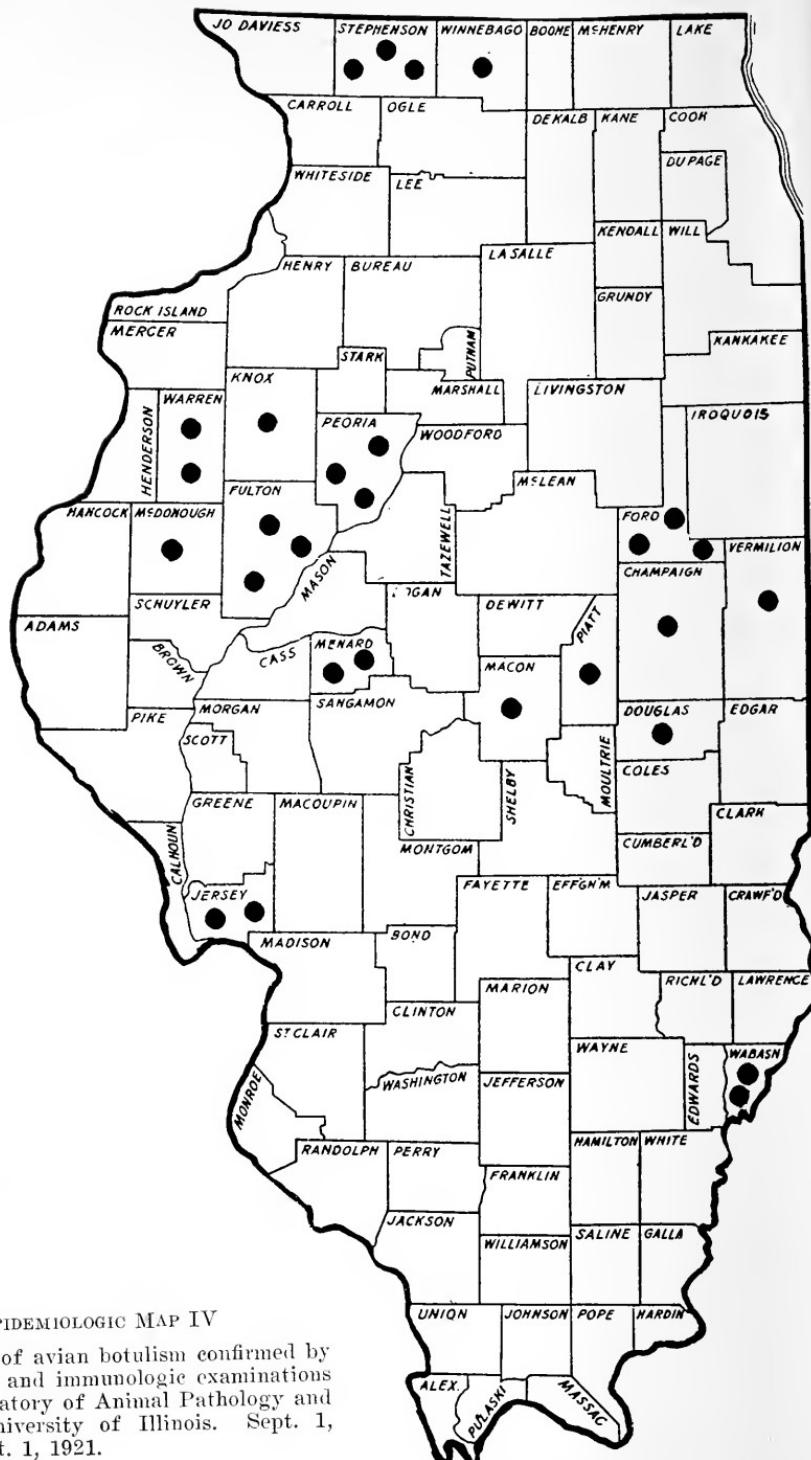
EPIDEMIOLOGIC MAP II

Total number of contaminated feeds or outbreaks of botulism in man and animals confirmed by bacteriologic and immunologic examinations in the Laboratory of Animal Pathology and Hygiene, University of Illinois, Sept. 1, 1920, to Sept. 1, 1921. In Illinois, 149. Outside of state, 9.



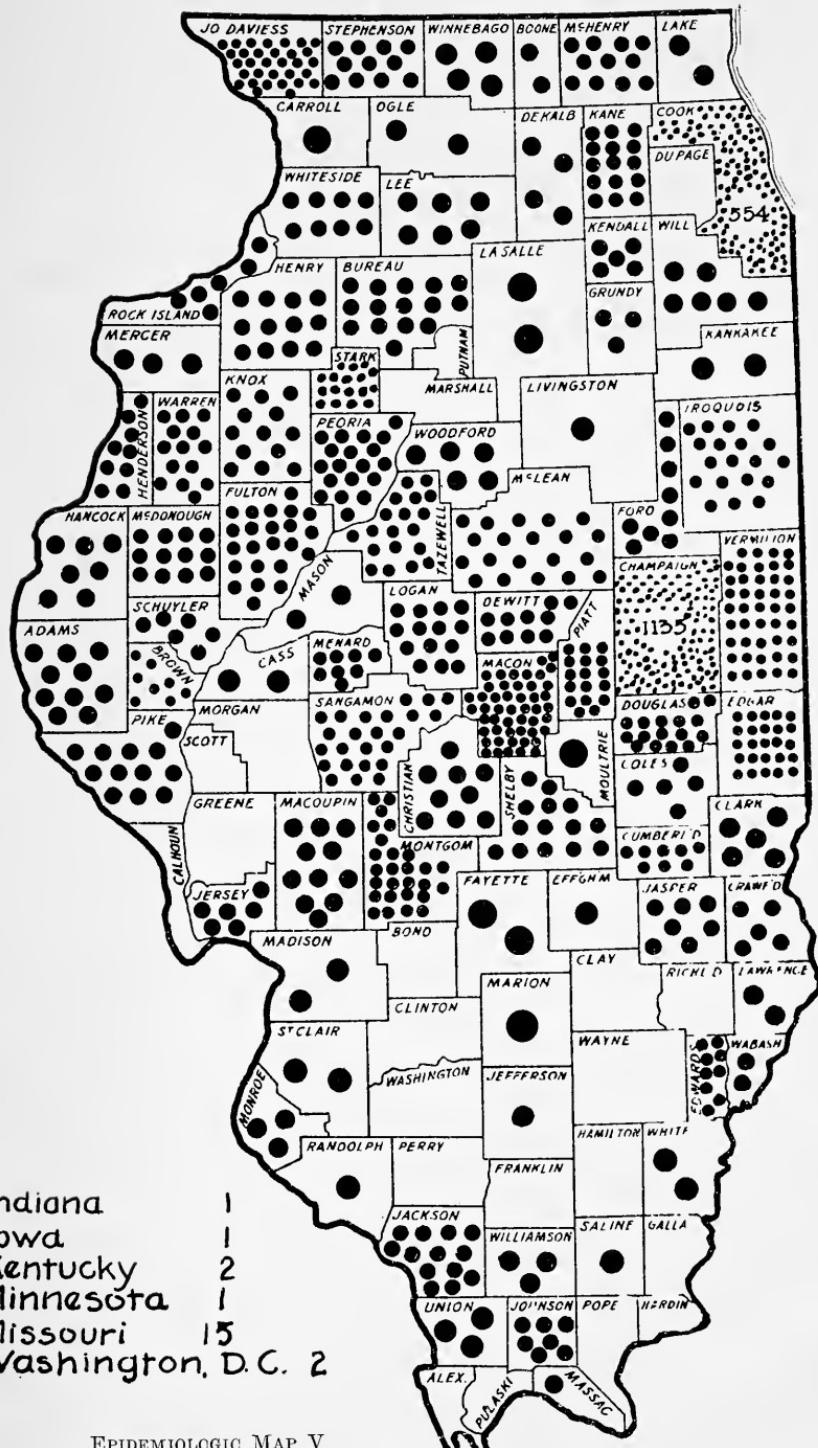
EPIDEMIOLOGIC MAP III

Swine botulism confirmed by bacteriologic and immunologic examination in the Laboratory of Animal Pathology and Hygiene, University of Illinois. Sept. 1, 1920, to Sept. 1, 1921.



EPIDEMIOLOGIC MAP IV

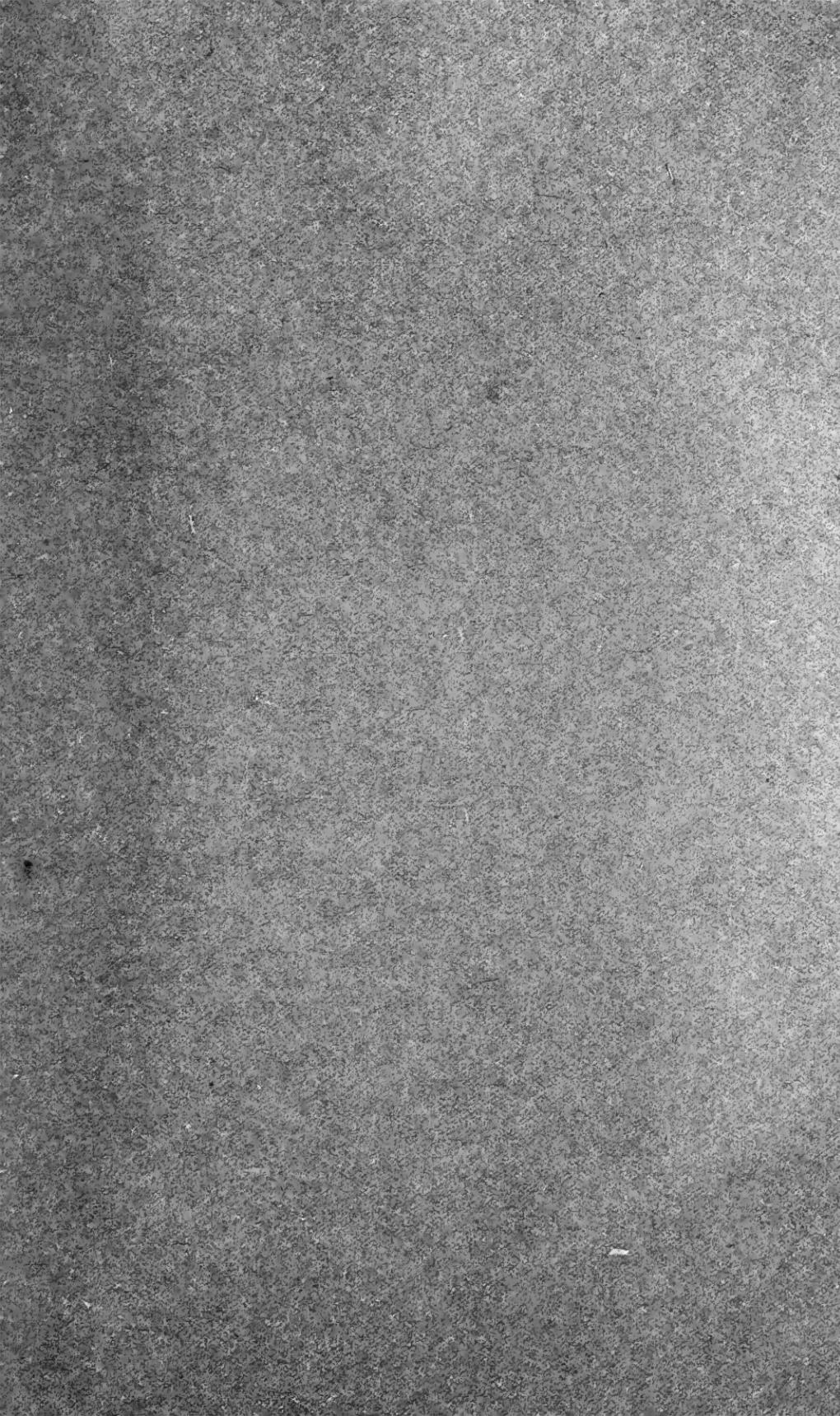
Outbreaks of avian botulism confirmed by bacteriologic and immunologic examinations in the Laboratory of Animal Pathology and Hygiene, University of Illinois. Sept. 1, 1920, to Sept. 1, 1921.

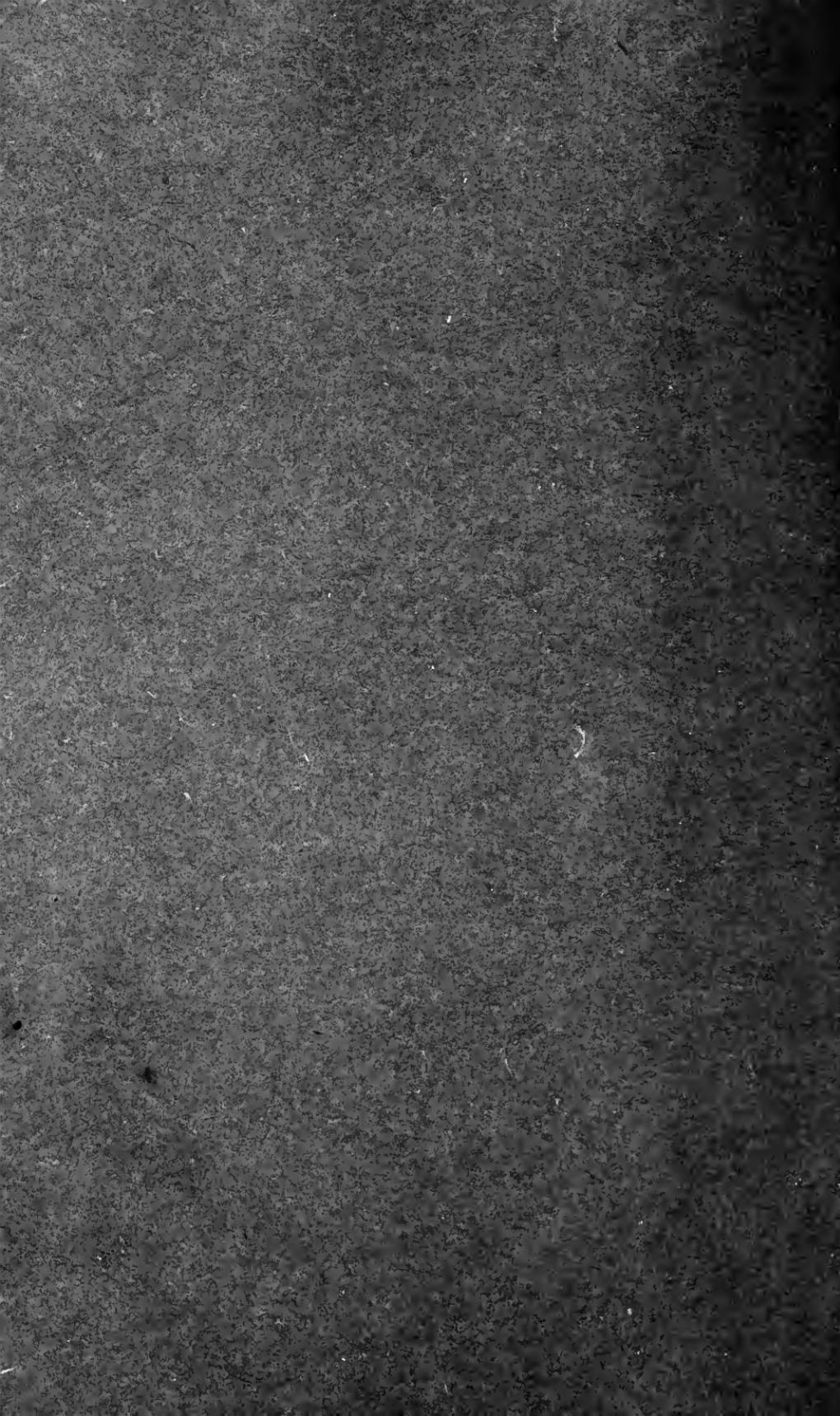


EPIDEMIOLOGIC MAP V

2505 specimens submitted to the Laboratory of Animal Pathology and Hygiene, University of Illinois, for bacteriologic, pathologic, and serologic diagnosis. Sept. 1, 1920, to Sept. 1, 1921.









COLUMBIA UNIVERSITY LIBRARIES

This book is due on the date indicated below, or at the expiration of a definite period after the date of borrowing, as provided by the rules of the Library or by special arrangement with the Librarian in charge.

RJ496.P2

Graham

G76

